



U.S. Department of Energy

Energy Efficiency and Renewable Energy

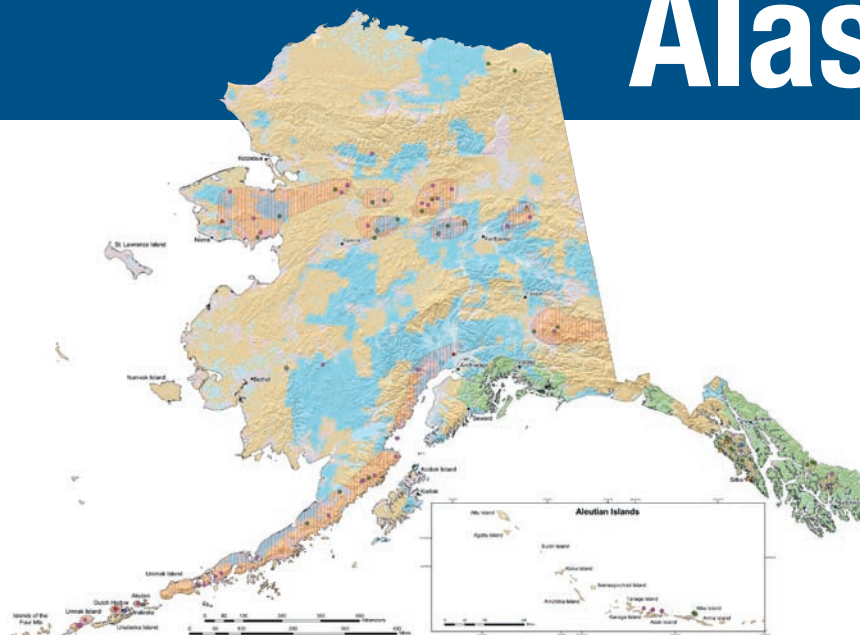
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable



Geothermal Technologies Program Alaska



This Olympic-size swimming pool at Circle Hot Springs, 162 miles northeast of Fairbanks, is geothermally heated, as is the spa hotel shown in the background.



Much of Alaska's southern coastal region is part of what is known as the Ring of Fire—a volcanic arc that nearly encircles the Pacific Basin. This includes the Aleutian Islands, the Aleutian Peninsula, and Baranof Island in southeast Alaska, all of which have excellent geothermal resources.

Interior Alaska also has several known geothermal areas, stretching from the White Mountains near Fairbanks in the east to the Seward Peninsula, near Nome in the west.

Throughout these geothermal areas, and in some isolated spots, are more than 100 hot springs and fumaroles with temperatures that range from 20°C (68°F) to more than 154°C (310°F).

Current Development

Alaska currently uses 14 of its hot springs primarily for spas or for space heating at the spas. Most notable among these are:

- Circle Hot Springs. The springs, which are located near the Yukon River 162 miles northeast of Fairbanks, produce 386 gallons of steaming water (at 60°C or 140°F) per minute to provide hot water for a spa swimming pool, space heat for the spa hotel, and heat for a greenhouse.

A few of these have the potential for generating electricity; others can be used for direct-use applications.

The drawback is that much of Alaska's geothermal resource is far from population centers. Yet, the U.S. Geological Survey (USGS) has identified several areas that have the potential for economically generating as much as 250 megawatts (MW) of geothermal electric power. This potential may even be far higher, especially if geothermal wells are drilled deep or in the likelihood of attaining supercritical geothermal fluids. Moreover, looking to the future, with the advent of a hydrogen economy Alaska may be able to exploit its geothermal resource to become a leader in the production of hydrogen for the world market.

- Manley Hot Springs. The village of Manley Hot Springs, which is about 160 miles west and north of Fairbanks, once had a thriving resort based around the local hot springs. The village is now a small, quiet town that still offers baths fed by the springs.
- Chena Hot Springs. The geothermally heated pool and facilities at Chena Hot Springs are 62 miles northeast of Fairbanks. It is a popular private resort that offers lodging, dining, mineral baths,

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



The geothermally heated pool and facilities is located at Chena Hot Springs, about 60 miles northeast of Fairbanks.

and swimming in the mineral springs. The water from the springs is also used for space heating and for cultivating plants in a greenhouse.

- **Baranof Island.** This island on the southeastern coast of Alaska has several hot springs—including Baranof Warm Springs, Goddard Hot Springs, and White Sulphur Hot Springs—all of which are used for bathing and relaxation.

Proposed Development

Although Alaska generates no geothermal electricity, several areas are being considered for development, including:

- **Unalaska** – This island is one of two places that the state of Alaska has drilled and tested specifically to determine the geothermal potential for electricity generation (the other is Pilgrim Hot Springs, see below). In the heart of the Aleutian chain, this island is home to the city of Unalaska—Alaska’s 11th largest city—whose population of 4,400 swells to more than 10,000 during fishing season. The city is home to several fish processing plants and to the port of Dutch Harbor, which is located on the nearby island of Amaknak and is connected by bridge to the city. The geothermal resource, with a temperature of approximately 202°C (395°F) at 2,000 feet below the surface, is on the volcano, Mount Makushin. The proposed project to exploit the geothermal resource will be privately financed and privately owned and operated. The first phase of the project will consist of an 18-MW geothermal electric generation facility, with electricity from the plant being transmitted 12 miles to the city of Unalaska and Dutch Harbor.

- **Akutan** – Next door to Unalaska is the smaller island of Akutan—home to both the Akutan volcano and to the village of Akutan, which has a large fish processing plant that employs 600 – 1,200 people during peak season. The proposal is to develop the island’s ample geothermal resource by building a 10-MW power plant to provide electricity to the processing plant and the village.
- **Chena Hot Springs** – A feasibility study is now being performed for a 475-kW facility to supply electricity to this resort area. If all goes well, construction will begin in late 2005.
- **Pilgrim Hot Springs** – Located 60 miles north of Nome and 80 miles south of the Arctic Circle, this historically significant site is a unique and lush oasis in the Alaskan tundra. In a region where permafrost is concrete-like and 300 feet thick, Pilgrim Hot Springs has about 2 square miles of thawed ground ideal for trees, shrubs, and truck gardens. This area is currently being explored not just for the production of approximately 5 MW of electric power from the local hot springs but also for geothermal heat. If the project is determined feasible, the hot springs could provide enough electricity and heat to make a reconstituted “Mary’s Igloo Village” (with a projected population of 250 people) self sustaining.
- **Adak** – The geothermal potential of the island of Adak was demonstrated by three wells drilled in 1977 by the U.S. Navy. Adak is a volcanic island that lies on the Great Circle navigation route halfway between Seattle and Japan. This, along with fact that the island is in the middle of one of the world’s richest fishing regions and that it has an established infrastructure—with an airport, deep-water port, major fuel-storage capabilities, utilities, and more—as a result of decades of being a U.S. Naval base, make Adak a prospective area for investment and growth. One of the investments being considered is the possibility of developing the island’s geothermal resource.

Economic Benefits

According to the Geo-Heat Center at the Oregon Institute of Technology, Alaska’s 14 hot springs provide more than 85 billion Btu’s of geothermal energy for use in spas, space heating, and greenhouses. Even though

this is a small amount of energy compared to the state's total energy consumption, it does serve to offset the use of other energy—generally that of diesel fuel. But the greatest impact has been on the tourist industry, where hot springs draw thousands of visitors who spend millions of dollars each year.

A far larger economic impact, however, will come with the development of geothermal electric power plants. The imminent 475-kW plant at Chena Hot Springs, for example, will address the immediate energy needs of the resort area by replacing \$300,000 of diesel fuel per year. By so doing, the plant will have a 3-year payback.

In addition to addressing the immediate energy needs of local communities, geothermal energy also offers the potential for communities to expand their industrial and employment base by providing a stable source of competitive electric energy to energy intensive users. This has already happened in Iceland, for example, where clean, state-of-the-art, high-energy-usage facilities have been built to take advantage of that country's low-cost, sustainable, geothermally generated electric energy.

In Alaska, the potential for using geothermal energy for industrial expansion is particularly promising to some of the islands of the Aleutian chain. The proposed geothermal plant at Akutan, for example, will do more than simply offset a substantial portion of the 43 million gallons of diesel consumed on the island per year, or alleviate the rising cost of diesel generated electricity by providing a local, low-cost, sustainable resource. It will also provide a clean energy resource that will help expand the fish processing industry, whose growth is currently limited by diesel emissions that cannot comply with clean-air regulations.

For nearby Unalaska the economic potential is even greater. Unalaska/Dutch Harbor—a sheltered, world-class, deep-water port—is the busiest fishing port in the United States, where hundreds of millions of pounds of fish and seafood are processed yearly. The city has a 4-star hotel, daily scheduled airline and air charter service, and a fish-processing industry that represents an investment of about \$1 billion.



Moreover, there is a likelihood on Unalaska (as elsewhere in the Aleutian arc) of attaining supercritical geothermal fluids (temperatures greater than 400°C or 752°F) at drillable depths. This would provide levels of energy at about an order of magnitude greater than comparable, lower temperature wells. The enormous heat, flow rate, and pressure generated would contribute to more efficient production of electric energy and hydrogen. This, together with a world-class port located near the Great Circle shipping route from major west coast ports to the Pacific Rim, would be a major benefit for Alaskan commerce, including energy commerce.

Technical Capabilities

The Alaska Energy Authority offers assistance and technical information on geothermal and other alternative energies. It also cooperates with the USGS, the U.S. Department of Energy, and others to assess the geothermal resource in Alaska and its potential uses.

The University of Alaska Fairbanks' Geophysics Institute and Department of Geology and Geophysics perform research and analyses on a variety of geophysical topics, including volcanology and geothermal energy.

Dutch Harbor, part of the city of Unalaska, is a world-class, deep-water port and the busiest fishing port in the United States. Developing the ample geothermal resource on the island of Unalaska would be a boon to the port and to the rest of the island's industry and commerce.



Part of the old orphanage at Pilgrim Hot Springs, Our Lady of Lourdes Church is still standing.

History

The history of Alaska's geothermal use is the history of the development of its hot springs. Some of these areas, such as the remote Serpentine Hot Springs on the Seward Peninsula, were used by Inupiat shamans before Charles McClellan "discovered" the springs in 1900. Today, the hot springs has a bathhouse, a large cabin for sleeping, and a nearby airstrip.

Pilgrim Hot Springs, also on the Seward Peninsula, had been used by local Alaskan natives well before modern recorded history. During the Nome Gold Rush days (1900+), this area became a popular place to visit, and to grow and cook fresh food. The worldwide pandemic flu epidemic of 1918-19 devastated this area, killing 1,200 people and leaving many children orphaned and homeless. Catholic Jesuit priests and Ursuline nuns built an orphanage—Our Lady of Lourdes Mission—at Pilgrim Hot Springs to take care of the children. The mission survived until 1942, by which time the children had grown. During World War II, Russian and American Pilots flew from Nome to Pilgrim Hot Springs and used the spa for rest and relaxation. Since the war, the area has largely been abandoned, with occasional visitors to the hot springs. Currently, however, there is a venture to explore the geothermal resource in the area and establish a self-sufficient village.

Goddard Hot Springs on Baranof Island was also visited by natives well before Europeans first saw it in the mid 1800s. By the late 1800s, the area had cabins and frame buildings for visitors. In the 1920s a hotel was built to accommodate visitors, but it fell into disuse in the 1940s. Today, the city of Sitka owns the hot springs and keeps a bathhouse there for recreational use.

Circle Hot Springs was used by the Athabascans well before the gold rush days. It was first encountered by non-native William Greats in 1893, whence it became a favorite of local miners, especially during the winter. It was developed into a resort in 1909.

Today's most popular Alaskan hot springs resort—Chena Hot Springs—was discovered by Robert and Thomas Swan in 1905. It quickly became a popular place for prospectors to visit for easing their aches and pains. By 1911 it had been developed into a small resort. It has since become a premier resort, attracting people from all over the world.



GEOPOWERING THE WEST

GeoPowering the West is a cooperative federal, state, and local effort to promote awareness of the vast geothermal energy resources in the western United States, including Alaska and Hawaii. GeoPowering the West partners with businesses, government officials, Native American groups, utilities, and energy consumers to expand the use of geothermal energy.

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